URBAN FOOD INSECURITY

by

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ABSTRACT

Trends indicate more and more people are moving from rural to urban areas. While urban areas provide benefits such as better access to healthcare, education, and employment, they also pose challenges for households to obtain adequate food. This dissertation seeks to evaluate the impact of urban agriculture on food insecurity, dietary diversity, and nutritional status. Additionally, since the role of wealth plays a significant part in determining a household's access to food, an analysis was conducted on positive deviant households to explore determinants of households that had greater food security despite being in the bottom two quartiles of a wealth index.

Data from 5-year-old children living in urban areas of Peru were used. Linear regression models were used to explore the association of urban agriculture on food security, dietary diversity, and nutritional status (height-for-age Z-score and weight-for-age Z-score). Linear regression models were also used to explore determinants of food security, dietary diversity, and nutritional status among poor Peruvian families in the bottom two quartiles of a wealth index. Logistic regression models were used to explore what factors contributed to being a "positive deviant" household, or a household in the bottom two wealth quartiles that reported being food secure, or food insecure without hunger.

Urban agriculture appears to have some potential to improve household and child food security for families living in urban areas of Peru. Households with greater household

size showed significantly worse food security indicators and may be in need of targeted food assistance. Donated food's significant, negative association with food security is likely a marker for those children who had already been identified with need for, and were receiving, food supplementation. Additional research is needed to identify ways to improve household dietary diversity.

Urban agriculture was not associated with better nutritional status indicators, but better socioeconomic status and maternal education were positively associated and highly correlated. While urban agriculture may represent one possible strategy for coping with food insecurity, its contribution should not be over-emphasized in the context of urban environments in Peru.

Among households in the bottom two quartiles of wealth, increasing wealth of urban residents was shown to help to mitigate food insecurity. Urban agriculture appears to be employed to help mitigate the negative impacts of food insecurity. Maternal education was also highly correlated with lower food insecurity scores. Efforts to improve a household's socioeconomic status and increase educational opportunities for girls should be considered by policy makers.

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CHAPTER 1

INTRODUCTION

Urbanization

In 2008, the number of people living in urban areas surpassed those living in rural areas for the first time in the world's history (UNFPA 2007). The United Nations Population Fund reports this trend will likely continue, with 1 out of 3 people expected to be living in urban centers by 2050 in 35 years (UNFPA 2011). Every year, the world's urban population increases by 60 million people and by 2050, it is expected that 70 percent of the world's population will be living in urban areas (UNICEF 2012).

Peru has also experienced this urban movement, with an estimated 22.8 million people living in urban areas in 2011, representing 77.6 percent of the country's population (UN 2014). Projections suggest that by 2025, over 27.7 million people will be living in urban centers in Peru, approximately 81.3 percent of the country's population (UNESA 2012).

As the number of people moving to cities increases, urban poverty, malnutrition, and hunger will also increase (UNICEF 2012). The increasing numbers of urban residents has many implications for the over one billion children that live in urban areas. Understanding the unique benefits and challenges that urban centers provide is important to direct policies and programs appropriately.

Benefits and Challenges of Urban Areas

Living in urban areas provides benefits of greater economic opportunities, access to education and health care, and improved sanitation. Cities create jobs and income, which is the major underlying reason for the increase in numbers moving to urban areas. Closer proximity of services like hospitals, clinics, schools, is also more advantageous in cities than in rural communities.

Despite the benefits that stem from urban areas, numerous challenges also exist. Those living in urban areas are susceptible to sudden swings in food prices, as many rely solely on markets to obtain food (Armar-Klemesu 2000). While interventions to help the rural poor are important, assistance for the urban poor is becoming increasingly urgent. Urban residents are just as vulnerable to scarcity and marginalization as rural dwellers, with already 1 in 3 people in urban areas living in substandard conditions (UN-Habitat 2003). Urban children tend to be better with regard to indicators of well-being such as reaching their 5th birthday, schooling, and sanitation. However, these figures are a collective look, where poorer urban children may be masked by children in wealthier homes. Wide disparities often exist in urban areas when it comes to child survival, opportunities for schooling, and nutritional status (UNICEF 2012).

Undernutrition

Households that struggle to access enough food are threatened by undernutrition. The World Health Organization views hunger and malnutrition as the gravest threats to public health (Sheeran 2008). Undernutrition is a form of hunger and is the underlying cause of 45% (3.1 million) deaths to children under the age of 5 (Black et al. 2013).

Children are particularly susceptible to negative impacts from hunger. Proper nutrition protects against illness and forms a solid foundation for child growth and development and adult outcomes, while undernutrition can lead to increased child morbidity and mortality and poor developmental outcomes (Adair 2013).

The Millennium Development Goals (MDGs) were created in 2000 by the United Nations and adopted by over 190 countries to serve as a framework to improve health and quality of life throughout the world. One of the first targets of these goals is to: “Halve, between 1990 and 2015, the proportion of people who suffer from hunger” (UN 2012). Recent estimates indicate that between 1990 and 2012, the prevalence of children under the age of 5 who were underweight dropped from 25 percent to 15 percent. The prevalence of children who were stunted (low height-for-age) also dropped from 33 percent to 25 percent between 2000 and 2012. Additionally, in 2012, it was estimated that 8 percent of children under the age of 5 suffered from an acute form of undernutrition called wasting (low weight-for-height), which was an 11% decrease since 1990 (UNICEF-WHO-World Bank 2012).

Despite these efforts to bring the problem of undernutrition to the forefront of the public health agenda, significant progress must be made in order to achieve this MDG. Much of the progress that has been made was achieved prior to 2007-2008, when food price spikes stalled the momentum (UNICEF 2009). Increasing food prices brought on by changing diets, economic growth, an expanding world population, urbanization, use of food crops for biofuel, and inappropriate agricultural policies are threatening the progress that has been made (UN 2008). In 2011-2013, nearly 842 million people suffered from chronic hunger (FAO 2013), with 101 million children underweight, 165 million stunted,

and 52 million wasted. (UNICEF-WHO-World Bank 2012).

Several outcome measures related to undernutrition were investigated. A description of these measures are described in the next few sections.

Food Insecurity

Food security is an important determinant of nutritional status and an underlying cause of undernutrition. It is defined as existing "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (World Food Summit 1996). Food security is measured at the individual, household, regional, national, and international level and is important to ascertain access, availability, and utilization of food and respond to deficiencies, otherwise known as food insecurity (FAO 2013).

While there is enough food in the world to enable everyone to have a productive and healthy life, accessibility is a key issue to household food security. Families who do not produce their own food suffer the most, because a larger proportion of their household expenditures go toward purchasing food. High food prices push people into poverty, with much of the increase in areas that already have a large population of people living in poverty (UN 2008).

Dietary Diversity

Having sufficient food is not the only important thing, but the right kind of food as well. A diverse diet helps meet the requirements for essential nutrients. Dietary diversity has been shown to be positively associated with nutritional status, independent

of socioeconomic factors (Arimond et al. 2004). Hatloy et al. found that lower food variety scores or dietary diversity scores were associated with almost twice the risk of being stunted or underweight among children aged 6–59 months living in urban areas of Mali (2000). Hoddinott et al. found that dietary diversity is a promising means of measuring household food access, and monitoring changes and impact, especially when resources for measurement are limited (2002). Steyn et al. found that dietary diversity indicators could also be used as a simple and quick indicator of micronutrient adequacy in the diet of South African children (2005).

Nutritional Status

UNICEF describes undernutrition as being underweight for one's age, too short for one's age (stunted), dangerously thin for one's height (wasted), and deficient in vitamins and minerals (UNICEF 2007). An estimated 100 million, or 1 in 6 children in developing countries is underweight (WHO 2011). Undernutrition is the underlying cause of 45% (3.1 million) deaths to children under the age of 5 (Black et al. 2013).

Stunting refers to being too short for one's age as compared to WHO child-growth standards. Nearly one-third of children in developing countries are stunted, a result of insufficient food, lack of vitamins and minerals, and frequent infections (UNICEF 2007). Approximately 165 million children age 5 years or younger are stunted (Black et al. 2013). In Peru, it is estimated that 24 percent of children under the age of 5 are stunted and over 5 percent are underweight (UNICEF 2012).

Having low weight compared to children of the same age and sex is referred to as being underweight. Underweight is the most common indicator collected in growth

monitoring and represents both poor linear growth and body proportions due to undernutrition (FAO 2011). Approximately 1 in 4, or 143 million children under the age of 5 in the developing world are underweight (UNICEF 2013).

Being underweight as a child can have significant consequences. Underweight status contributed to an estimated 1,957,530 deaths (19.0% of deaths to children <5 years) and 81.3 million DALYs (18.7% of DALYs in children <5 years) in children under 5 years of age in 2004. It was also found that an estimated 35% of child deaths could be attributed to child underweight and intrauterine growth restrictions (Black et al. 2008).

Urban Agriculture

Addressing food insecurity on a household level in urban areas is an important public health priority. As such, we looked at urban agriculture as an exposure that could be amenable for implementation as a program to address food insecurity. Urban agriculture, defined as engaging in agricultural or livestock production within cities or towns, has shown promise in helping to shield families from food insecurity and low dietary diversity (Zezza et al. 2008). In a study in Uganda, Maxwell et al. found that urban agriculture was associated with improved quantity and quality of food consumption (1998). Using representative data from 15 developing or transitional countries, Zezza et al. (2010) found an association between urban agriculture and indicators of dietary diversity in a majority of the countries they evaluated. While numerous studies have examined the link between urban agriculture and food security, very few have used quantitative data to explore this relationship (Zezza et al. 2010). No studies have been identified that have investigated urban agriculture in Peru.

Actionable Targets for Intervention

In addition to looking at the exposures outlined above, we studied "positive deviant" families to see if there were determinants that would be good to promote as interventions to address food insecurity. Positive deviants in this case were households that were in the bottom two quartiles of wealth, yet reported being food secure or food insecure without hunger. Wealth is a strong determinant of being food secure. Identifying factors among households that have lower wealth yet are still able to live without hunger in the household can lead to interventions to help many that struggle in urban settings.

Young Lives Study

The analysis found herein is a retrospective cross-sectional study nested within a larger cohort study called Young Lives, a 15-year, multicountry longitudinal study. Young Lives was initiated by researchers from Oxford University in England, and is funded by UK Aid from the Department for International Development and by the Netherlands Ministry of Foreign Affairs. The study is following 12,000 children in four countries: Peru, Ethiopia, India (state of Andhra Pradesh), and Vietnam. Two cohorts of children in each country have been enrolled in the Young Lives study: approximately 2,000 children who were born in 2001-02 and 1,000 children who were born in 1994-95. Five rounds of data will be collected, with the final round scheduled for 2016. Although the broader Young Lives study is longitudinal, revisiting the same children in later years, this analysis takes a cross-sectional approach, looking at children from the younger cohort in Peru at their second data collection point at approximately age 5.

Peruvian children were enrolled in urban, periurban, and rural areas from each of

the main geographic regions: the western coastal plain, the rugged mountainous central area of the Andes, and the eastern lowland jungle of the Amazon Basin. Although the study collected data from both urban and rural areas, only data from households living in urban areas were used.

Peru is considered an upper-middle income country and has experienced significant economic growth during the last decade. Peru, along with the other Young Lives countries, was selected to show a range of cultural, economic, geographical, political, and social environments (Young Lives 2011).

Specific Aims

The specific aims for this dissertation include:

1. Explore whether families living in urban areas of Peru that grow their own crops and raise livestock have better food security and dietary diversity indicators than urban families in Peru that do not grow their own crops or raise livestock by using linear regression to analyze associations.
2. Explore whether families living in urban areas of Peru that grow their own crops and raise livestock have better nutritional status indicators than urban families in Peru that do not grow their own crops or raise livestock by using linear regression to analyze associations.
3. Explore household and community determinants of food security, dietary diversity, and nutritional status in urban areas of Peru by investigating responses to questionnaires given to households of 4-5-year-old Peruvian children.

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CHAPTER 2

THE ASSOCIATION OF URBAN AGRICULTURE WITH FOOD SECURITY AND DIETARY DIVERSITY AMONG URBAN FAMILIES IN PERU

Abstract

Objectives

The objective of this paper is to evaluate the association between urban agriculture and food security and dietary diversity in households and among children living in urban areas of Peru.

Design

Using data from the Young Lives study, food security indicators from 1,081 children living in urban areas were evaluated based on whether or not their families participated in growing crops or raising livestock during the previous year. Separately, dietary diversity scores from 1,078 children were used to test for an association with urban agriculture. Covariates of maternal education, socioeconomic status, household size, and donated food were included in regression models.

Results

Urban agriculture was positively associated with food security at the household level (p=0.038) and at the child level (p=0.020). Urban agriculture was not significantly associated with dietary diversity (p=0.091). Maternal education and socioeconomic status were highly correlated with food security at both the household and child levels, as well as with dietary diversity. Household size and donated food were significantly associated with lower food security at both the household and child levels (p=0.018, and p=0.001, respectively).

Conclusions

Urban agriculture appears to have some potential to improve household and child food security for families living in urban areas of Peru. Households with greater household size showed significantly worse food security indicators and may be in need of targeted food assistance. Donated food's significant, negative association with food security is likely a marker for those children who had already been identified with need for, and were receiving, food supplementation. Additional research is needed to identify ways to improve household dietary diversity. Efforts to improve a household's socioeconomic status and educational opportunities for girls should be considered by policy makers.

Introduction

In 2008, the world's population living in urban areas surpassed those living in rural areas for the first time (UNFPA 2007). The United Nations Population Fund reports

this trend will likely continue, with 2 out of 3 people expected to be living in urban centers by 2050 (UNFPA 2011). Peru has also experienced this urban movement, with an estimated 22.8 million people living in urban areas in 2011, representing 77.6 percent of the country's population (UN 2014). Projections suggest that by 2025, over 27.7 million people will be living in urban centers in Peru, approximately 81.3 percent of the country's population (UNESA 2012).

Living in urban areas provides the benefits of greater economic opportunities, access to education and health care and improved sanitation. However, numerous challenges also exist. Those living in urban areas are susceptible to sudden swings in food prices, as many rely solely on markets to obtain food (Armar-Klemesu 2000).

Increases in food prices can negatively impact food security, a condition defined as consistent "physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (World Food Summit 1996). Food security has been measured at the individual, household, regional, national, and international levels. Measuring food security is important to ascertain access, availability, and utilization of food and respond to deficiencies, otherwise known as food insecurity (FAO 2013). Food insecurity has been shown to be associated with poor nutritional outcomes like stunting and wasting in children (Hackett et al. 2009).

Numerous tools and methodologies have been developed to help measure food security on various levels. One such indicator is dietary diversity, which is a qualitative measure of food consumption that refers to the number of individual foods or food groups that are consumed over a certain period of time. Dietary diversity serves as a proxy for

nutrient adequacy by determining the variety of foods consumed (FAO 2011). The Food and Agriculture Organization (FAO 2011) and World Food Programme (WFP 2009) both use dietary diversity as one component in analyzing overall food security.

Addressing food security on a household level in urban areas is seen as an important public health priority. Urban agriculture, defined as engaging in agricultural or livestock production within cities or towns, has shown promise in helping to shield families from food insecurity and low dietary diversity (Zezza et al. 2008). In a study in Uganda, Maxwell et al. found that urban agriculture was associated with improved quantity and quality of food consumption (1998). Using representative data from 15 developing or transitional countries, Zezza et al. (2010) found an association between urban agriculture and indicators of dietary diversity in a majority of the countries they evaluated. While numerous studies have examined the link between urban agriculture and food security, very few have used quantitative data to explore this relationship (Zezza et al. 2010). No studies using quantitative data have been identified that have investigated urban agriculture's effect on food security in Peru.

Improving household food security has been recognized as an important element in reducing the number of hungry children and families in the world. Despite numerous interventions that have attempted to increase household food security, there still remain significant gaps in knowledge as to which interventions or actions are appropriate or helpful. Tackling food insecurity also provides support to combat threats to early childhood development, which can lead to better opportunities for children to escape the cycle of poverty and improve their situation for themselves and their families. This study attempts to address this gap by investigating urban agriculture's association with the

outcomes of food security and dietary diversity separately. Results from this study may help inform future interventions on improving food security and dietary diversity.

Methods

Study Setting

Data in this study come from a 15-year, multicountry longitudinal study called Young Lives. Young Lives is directed by researchers from Oxford University in England, and is funded by UK Aid from the Department for International Development and by the Netherlands Ministry of Foreign Affairs. The study follows 12,000 children in four countries: Peru, Ethiopia, India (state of Andhra Pradesh), and Vietnam. Two cohorts of children were enrolled from each country. The older cohort included approximately 1,000 children from each country who were born in 1994-95, and the younger cohort included approximately 2,000 children who were born in 2001-02. Five rounds of data will be collected, with the final round scheduled for 2016. For the purposes of this study, household data from the younger cohort in Peru during the second round of data collection were used.

Peru is considered an upper-middle income country and has experienced significant economic growth during the last decade. Peruvian children were enrolled in urban, periurban, and rural areas from each of the main geographic regions: the western coastal plain, the rugged mountainous central area of the Andes, and the eastern lowland jungle of the Amazon Basin, representing a range of cultural, economic, geographical, political, and social environments (Barnett 2012). Although the study collected data from

both urban and rural areas, only data from households living in urban areas were used for this study because the focus was to examine the impact of urban agriculture.

Study Population

Round one of the Young Lives study in Peru was collected in 2002. Children ages 6-17.9 months (not multiple gestation) were originally enrolled in the study. The sample was derived by first dividing the country into geographic regions by population size. Using a map of the 1,818 districts in Peru, the research team ordered the districts according to a poverty index, which included factors such as infant mortality, housing, schooling, roads, and access to services. Districts in the top 5 percent were excluded from the study and the rest were used to obtain sample sites that included 75 percent poor and 25 percent nonpoor in the population (Wilson 2003).

A random starting spot was chosen and a computer identified a sample of districts which would cover rural, urban, peri-urban, and jungle areas. A random population area within each district was then chosen. Using census data, a randomly selected neighborhood was chosen, along with a street block identified using a random number table. Fieldworkers contacted each home starting at the selected block and then on neighboring blocks until the required number of children were enrolled. A total of 36,375 homes were visited and 2,751 children were initially recruited for both the younger and older cohorts in Peru (Escobal 2003).

This study uses data from the second round of sampling, at which time participants were approximately 5 years old when homes were visited during November 2006 to May 2007. Efforts were made to reduce attrition bias from round one through

contacting households that may have moved during that time. Attrition from round 1 to round 2 was 3.52 percent, considered low when compared to similar studies (Outes-Leon 2008).

Data Collection

Fieldworkers went through extensive training to ensure questionnaires were administered in a standardized manner (Escobal 2008). The round two household questionnaire included information on: demographics; socioeconomic and cultural characteristics; income and expenses; availability of assets and social capital; strategies for dealing with adversity; access to and use of public and private services; and self-perception of the family's well-being.

Informed consent was obtained from each parent or guardian before a child was enrolled in the study and before each survey round. Children were not required to participate, even with their parent's consent. Efforts were made by fieldworkers to ensure parents/guardians and children understood that data were collected for a research project and not the development of a project that could change their lives, so that expectations were realistic. All data collected were archived anonymously.

Institutional Review Board approval was obtained in the United Kingdom from London South Bank University, London School of Hygiene and Tropical Medicine, the University of Reading and from the International Nutrition Institute Ethics Committee in Peru. The Peru Ministry of Health also was involved and provided approval, in addition to local community leaders. De-identified data were used for this analysis.

Food Security

Household food security was measured using an adapted version of the United States Department of Agriculture (USDA) Household Food Insecurity Measure (Bickel 2000). This measure was modified and tested by Young Lives for use in the household questionnaire in Peru (Vargas et al. 2010). The food insecurity score was calculated using responses to 15 core questions that related to whether the household had enough food or money to meet dietary needs. Anxiety over lack of food and quality of food for both adults and children was also assessed, along with questions about the frequency or coping strategies used for food insecurity.

Fieldworkers conducted the survey in person with a caregiver of the child that was enrolled in the study. Each question asked if (yes/no), or how often (almost every month, some months, only 1 or 2 months, did not happen) a situation of food insecurity was experienced by the household over the previous 12 months. Each situation that was experienced by the family in the previous year was given a value of 1, while each situation that was not experienced by the family was given a value of 0. Scores from the questions were summed, so that the higher the score, the worse the household's food insecurity situation was.

Results from the survey were used as a continuous measure for regression results. Results were also categorized into a 10-point scale, mirroring the USDA descriptions of 'food secure' (0 to 2.32), 'food insecure without hunger' (2.33 to 4.56), 'food insecure with moderate hunger' (4.57 to 6.53), and 'food insecure with severe hunger (6.54 to 10). A "child food insecurity score" was calculated as a continuous measure using 6 of the 15 questions in the module that directly related to situations experienced by children.

Dietary Diversity

A simplified dietary diversity module was used to determine individual dietary diversity scores for the children enrolled in the Young Lives study. Individual dietary diversity provides a snapshot of nutrient adequacy and evaluates the variety of foods consumed by the child. The Young Lives survey followed general guidelines for collecting and analyzing dietary diversity developed by the Food and Agriculture Organization (FAO) (Kennedy et al. 2011).

Primary caregivers of Young Lives children were asked whether the child had consumed certain foods in 12 different food groups during the previous 24-hour period. These food groups included: cereals, roots/tubers, legumes or nuts, milk/milk products, eggs, meat/offal, chicken, fish/seafood, oil/fat, sugar/honey, fruits, and vegetables. Examples of each food group were given if needed (i.e., lentils, beans, or peas for the "legume" food group).

Each positive response was given a score of "1", with the total number of food groups represented in the previous 24 hours serving as the individual dietary diversity score for the child. This score was used as a continuous measure in all analyses.

Urban Agriculture

Participation in urban agriculture was determined by families living in urban areas that indicated they had grown crops or raised livestock during the previous 12 months. Families that had grown at least one crop or raised one type of livestock were recorded as having participated in urban agriculture. The time period of 12 months allowed for urban agriculture activity to be recorded, regardless of the time of year.

Covariates

Previously described determinants of food security and dietary diversity included the number of children in the household, socioeconomic status, maternal education, and access to donated food. The size of the household was collected at each round of the Young Lives study by asking the caregiver how many people were living in the household.

Socioeconomic status was estimated using a wealth index that included a composite score from 0 to 1. This measure was calculated using housing quality (number of rooms, household size, home construction materials, and type of floor), consumer durables (radio, refrigerator, bicycle, TV, vehicle, mobile phone, landline phone, iron, blender, gas or electric cooker, and record player), and access to services (drinking water, electricity, toilet, and fuel) (Escobal et al. 2003).

Maternal education was determined by the number of years the mother of the child had completed. A categorical variable was constructed based on completion of the following grade levels: 0–5, 6, 7–10, 11–12, and some postsecondary.

Donated food was determined from caregivers' responses on whether anyone in their household had received donated food.

Data Analysis

Descriptive analysis was conducted on child, maternal, and household characteristics. Linear regression was run using Stata® (Version 8.0, College Station, TX) to analyze associations between participation in urban agriculture and the outcomes of food security and dietary diversity separately.

A total of 1,086 children in the Young Lives study were living in urban areas when the second round data were collected in Peru. Two observations were dropped from the analysis because maternal education was not known. For the food security analysis, three observations were dropped due to incomplete information on the food security questionnaire, leaving the total number of observations at 1,081. For the analysis on dietary diversity, in addition to the two observations dropped for lack of information on maternal education, an additional six observations were dropped because of incomplete information on the dietary diversity module (1,078 total observations).

Results

The mean age of children was just less than 5.5 years (Table 2.1). The number of males and females were similar (50.97% males). The average number of years of maternal education was just under 10 years. Ethnicity was predominantly Mestizo (82.33%), with Quecha (9.90%), White (3.42%), Aymara (2.96%), and other (1.39%) being represented. Maternal language spoken was largely Spanish (86.77%). Urban areas were represented in each of the regions of Peru, with most respondents from the coastal region (63.55%), followed by the mountain region (27.38%), and then the jungle region (9.07%). The mean score on the wealth index for this population was 0.62, based on a scale from 0 to 1. Households that reported having received donated food were 57.08% and the average household size was 5.14 persons. Just under half of households reported participating in urban agriculture during the previous 12 months (47.09%).

Food Insecurity

Over two-thirds (67.16%) of households reported that in the last 12 months they were worried food might run out (Table 2.2) and over half (57.72%) reported that the food bought just wasn't enough. Adults were more likely than children to cut the size of meals (18.69% and 15.82%, respectively) and a small percentage of both adults (3.98%) and children (1.20%) reported having not eaten for an entire day. Just over a quarter (26.83%) reported that children were not eating enough, and 14.80% reported that adults ate less than they felt they should.

The mean household food insecurity score was 3.6 and the child food insecurity score was 1.6. As noted earlier, a higher score indicates greater food insecurity. Table 2.3 shows a breakdown using the USDA Food Insecurity Score standards. Half of the families reported being food secure (50.88%) and half reported being food insecure. Of those who reported being food insecure, 32.19% reported being food insecure without hunger, 10.55% reported being food insecure with moderate hunger, and 6.39% reported being food insecure with severe hunger.

Using linear regression, families who participated in urban agriculture were significantly more likely to have better (lower) food insecurity scores (Table 2.4). Because affirmative answers indicate food insecurity, the higher the food security score, the more food insecure the family was. Mothers with a complete high school or advanced education were also significantly more likely to have better (lower) food insecurity scores. Wealth index was highly correlated with lower food insecurity scores, indicating that the wealthier the family is, the better (lower) the food insecurity score is for the household. Household size and having received donated food were significantly

associated with less favorable (higher) food insecurity scores.

Regression results for the child food insecurity score were similar to the household results (Table 2.5). Urban agriculture was significantly associated with lower (better) food insecurity scores. Maternal education of at least 11 years and socioeconomic status were highly correlated with lower food insecurity scores. Household size was significantly associated with worse child food insecurity, but depended on the number in the household. Households with 6-7 household members showed greater food insecurity (0.59, P<0.000) than households with 4-5 members (0.22, 0.036). Households with 8 or more members were not statistically associated with food insecurity (p=0.072). Donated food was not a statistically significant predictor of child food security (p=0.325).

Dietary Diversity

A majority of families (58.7%) reported relying on only a few kinds of low-cost foods to feed their children (Table 2.2). Additionally, over half said that they were not able to feed children a balanced meal (56.3%). The mean dietary diversity score was 8.8 (6.1 SD). A majority of children had eaten foods from between seven and ten different food groups (n=951) (Table 2.6). A range of values has not been established to determine levels of adequacy in the dietary diversity score (Kennedy 2011).

Using linear regression, urban agriculture was not statistically associated with dietary diversity at the p<0.05 level (Table 2.7). Maternal education of 11–12 years or postsecondary education was positively associated with dietary diversity. Wealth index was positively correlated with dietary diversity. Household size and donated food were not associated with dietary diversity either independently or in a multivariate model.

Discussion

Our results suggest that urban agriculture could play a part in decreasing food insecurity in urban areas for both households and children. Dietary diversity, which is often used as a proxy for food security in nutritional studies, was not associated with urban agriculture at the $p<0.05$ level. In both the food security and dietary diversity analyses, maternal education of 11 or more years, and greater socioeconomic status were strongly associated with better outcomes.

One strength of this study is the use of a multivariate framework. Most of the literature on urban agriculture involves case studies, and very few have used quantitative data to test for associations between food security indicators and urban agriculture. The methods involved in collecting data were also a strength, providing solid, reliable quantitative data to describe the food insecurity situation among households.

Our estimate of the percentage of families that were food insecure (50.9%) is similar to an estimate by Vargas and Penny (2009) who found 53% of families in an urban area of Lima, Peru were food insecure. This study included 100 households in Lima, and was conducted to help adapt the food insecurity scale for use in the Young Lives study. When comparing the sample in Lima (urban) to other rural areas, Vargas et al. found that Lima households did not have improved food security, suggesting that food security in the city could be as big or a bigger problem than in rural areas of Peru (2010).

Similar to previous studies, our analysis has shown that urban agriculture could be a viable option for improving food security and dietary diversity, which has been found in other studies (Zezza et al. 2010; Yuedall et al. 2007; Maxwell et al. 1998). Zezza et al. looked at nationally-representative data on dietary diversity and found in 10 of the 15

countries analyzed that participation in urban agriculture was associated with greater dietary diversity and calories available in households (2010). The importance of income and maternal education have been well described in previous work (Garrett et al. 1999; Yuedall et al. 2007; Dossa et al. 2011). Policies that encourage educational attainment of girls is recommended. This may help benefit the household's economic situation, paving the way for a better food security situation.

The impact of household size was also an interesting finding. The continuous measure of the household food security scale showed that the larger the household, the worse the food security situation was. In the child food security model, households with 8 or more people were not significantly associated with worse food security, where households with fewer individuals were significantly associated. One possibility is that where there are more people in the household, there may be a better possibility that some of those individuals are contributing to the household's income or access to food. Donated food was actually associated with poorer food insecurity outcomes, which could possibly be due to the fact that families with a poorer food insecurity status are in need of, and have received, donated food.

Our definition of urban agriculture, food security, and dietary diversity were limited by the variables in the existing dataset and differed from definitions in other studies. This may hinder comparability between our work and previously published studies. A standard definition for urban agriculture involving the amount of land or the different types of crops grown is recommended for future studies. It is also important to note that other studies have found that urban agriculture is not a major economic activity, but data do confirm in a number of countries that many in the urban population rely on

crop and livestock production to some extent for household consumption (Zezza et al. 2010).

Conclusion

Urban areas will no doubt continue to see increases in population in the coming years. Because urban families are much more susceptible to sudden increases in food prices, it is important to identify ways to help prevent or mitigate negative impacts on household food security resulting from market forces. Although urban agriculture is not seen as the answer to relieving hunger in all urban areas, its impact should not be dismissed. Families that are significantly impacted by rises in food prices could use urban agriculture as a means to minimize the negative impact, as well as increase diversity in the diet. Urban areas are all different and any potential for urban agriculture will need to be investigated in a location-specific manner. Where possible, policies could be established by governments and urban planners to promote the use of urban agriculture to improve food security and dietary diversity.

Table 2.1 Characteristics of study population

Characteristics	N=1,081
Child Characteristics	
Child age in months	65.9 ± 4.1
Male (%)	50.97%
Female (%)	49.03%
Maternal Characteristics	
Maternal education in years	9.97 ± 3.75
Maternal ethnicity (%)	
Mestizo	82.33%
Quechua	9.90%
White	3.42%
Aymara	2.96%
Other	1.39%
Maternal language	
Spanish	86.77%
Quechua	8.88%
Aymara	3.70%
Spanish & Quechua	0.37%
n/a	0.28%
Household Characteristics	
Region (%)	
Coast	63.55%
Mountain	27.38%
Jungle	9.07%
Wealth index (score 0-1)	0.62 ± 0.17
Donated food (%)	57.08%
Household size	5.14 ± 2.01
Urban Agriculture	
Crops or Livestock (%)	47.09%

Table 2.2 Household and child food insecurity scale (Vargas, 2010)

	Item	Item Description	Yes	No	%	SD
Food supply anxiety	1	Worried food might run out	726	355	67.16%	0.47
	2	Food we bought just wasn't enough	624	457	57.72%	0.49
Food quality anxiety	3	Did not have enough to eat balanced meals	76	1,005	7.03%	0.26
	4*	Relied on only a few kinds of low-cost food to feed children	635	446	58.74%	0.49
	5*	Could not feed the children a balanced meal	611	470	56.25%	0.50
Children's food intake	6*	Children were not eating enough	290	791	26.83%	0.44
Adults' food intake	7	Adult cut the size of meals or skipped them	202	879	18.69%	0.39
	8	Eat less then felt should	160	921	14.80%	0.36
	9	Hungry but did not eat	144	937	13.32%	0.34
	10	Lose weight	79	1,002	7.31%	0.26
	11	Adult did not eat for a whole day	43	1,038	3.98%	0.20
Children's food intake	12	Cut the size of children's meals	171	910	15.82%	0.37
	13*	Children didn't eat because of a lack of food	18	153	1.67%	0.13
	14*	Children ever hungry	107	974	9.90%	0.30
	15*	Children did not eat for a whole day	13	1,068	1.20%	0.11

*Used to determine child food security score

Table 2.3 Household food insecurity score

	Score	%	n
Food secure	0.00	21.28	230
	0.67	10.73	116
	1.33	10.08	109
	2.00	8.79	95
	Subtotal	50.88	550
Food insecure without hunger	2.67	16.37	177
	3.33	10.55	114
	4.00	5.27	57
	Subtotal	32.19	348
Food insecure with moderate hunger	4.67	4.26	46
	5.33	3.24	35
	6.00	3.05	33
	Subtotal	10.55	114
Food insecure with severe hunger	6.67	3.33	36
	7.33	0.93	10
	8.00	1.11	12
	8.67	0.74	8
	9.33	0.19	2
	10.00	0.09	1
	Subtotal	6.39	69
	Total	100	1,081

Table 2.4 Regression results for household food insecurity

		Unadjusted Model		Adjusted Model		
Independent Variable	N	Estimate	95% CI	Estimate	95% CI	P-value
Urban Ag	1,081	0.29	-0.08, 0.67	-0.38	-0.74, -0.21	0.038
Maternal Education						
0-5	120	--	--	--	--	--
6	125	-0.40	-1.16, 0.36	-0.74	-0.80, 0.65	0.842
7-10	222	-0.62	-1.29, 0.05	0.08	-0.58, 0.73	0.818
11-12	303	-1.76	-2.40, -1.11	-0.89	-1.53, -0.26	0.006
Some postsecondary	311	-2.38	-3.02, -1.74	-1.00	-1.67, -0.34	0.003
Wealth index	1,081	-6.59	-7.61, -5.58	-5.49	-6.65, -4.35	0.000
Household size	1,081	0.08	-0.01, 0.18	0.10	0.02, 0.20	0.018
Donated food	1.081	1.23	0.86, 1.61	0.61	0.24, 0.98	0.001

Table 2.5 Regression results for child food security

		Unadjusted Model		Adjusted Model		
Independent Variable	N	Estimate	95% CI	Estimate	95% CI	P-value
Urban Ag	1,081	0.06	-0.11, 0.23	-0.19	-0.36, -0.03	0.020
Maternal Education						
0-5	120	--	--	--	--	--
6	125	-0.13	-0.47, -0.21	-0.01	-0.33, 0.32	0.973
7-10	222	-4.14	-0.72, -0.11	-0.14	-0.43, 0.16	0.363
11-12	303	-0.78	-1.06, -0,49	-0.43	-0.72, -0.14	0.004
Some postsecondary	311	-0.95	-1.24, -0.67	-0.42	-0.72, -0.12	0.007
Household Size						
1-3	189	--	--	--	--	--
4-5	546	0.18	-0.05, 0.41	0.22	0.01, 0.43	0.036
6-7	216	0.57	0.30, 0.83	0.59	0.34, 0.84	0.000
8+	130	0.22	-0.09, 0.53	0.26	-0.23, 0.55	0.072
Wealth index	1,081	-2.70	-3.16, -2.25	-2.39	-2.92, -1.88	0.000
Donated food	1,081	0.34	0.17, 0.51	0.08	-0.08, 0.25	0.325

Table 2.6 Distribution of dietary diversity scores

Number of different food groups eaten in previous 24 hours	Frequency	Percentage
3	1	0.09
4	3	0.28
5	21	1.94
6	56	5.18
7	161	14.89
8	323	29.88
9	304	28.03
10	163	14.99
11	41	3.79
12	4	0.37
Total	1,078	100

Table 2.7 Regression results for dietary diversity

		Unadjusted Model		Adjusted Model		
Independent Variable	N	Estimate	95% CI	Estimate	95% CI	P-value
Urban Ag	1,078	0.03	-0.13, 0.18	0.14	-0.02, 0.30	0.091
Maternal Education						
0-5	120	--	--	--	--	--
6	125	0.13	-0.19, 0.46	0.09	-0.02, 0.30	0.610
7-10	221	0.14	-0.15, 0.43	0.04	-0.25, 0.34	0.783
11-12	302	0.43	0.15, 0.71	0.31	0.03, 0.60	0.032
Some postsecondary	310	0.60	0.32, 0.87	0.41	0.11, 0.71	0.007
Household Size						
1-3	189	--	--	--	--	--
4-5	546	0.27	-0.75, 1.28	0.17	-0.86, 1.19	0.746
6-7	216	0.48	-0.72, 1.67	0.39	-0.84, 1.61	0.536
8+	130	1.04	-0.32, 2.41	0.88	-0.52, 2.29	0.216
Wealth index	1,078	1.17	0.72, 1.63	0.92	0.40, 1.44	0.001
Household size	1,078	-0.01	-0.05, 0.03	-0.01	-0.05, 0.03	0.480
Donated food	1,078	-0.11	-0.27, 0.04	0.003	-0.16, 0.17	0.971

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CHAPTER 3

THE ASSOCIATION OF URBAN AGRICULTURE AND NUTRITION AMONG URBAN CHILDREN IN PERU

Abstract

Objective

The objective of this paper is to evaluate the association between participation in urban agriculture and nutritional status among children living in urban areas of Peru.

Design

Using data from the Young Lives study, we evaluated the association of urban agriculture with height-for-age Z-scores (HAZ) and weight-for-age Z-scores (WAZ) of 1,083 children living in urban areas. Covariates of maternal education, socioeconomic status, household size, donated food, and participation in Peru's Glass of Milk program were included in regression models.

Results

Urban agriculture was not significantly associated with better HAZ ($p=0.366$) or WAZ ($p=0.100$). Socioeconomic status and maternal education were significantly, positively associated with better HAZ and WAZ. Household size was not significantly

associated with HAZ, but was negatively associated with WAZ among households with 8 or more people. Households that received donated food were significantly, negatively associated with both HAZ and WAZ.

Conclusions

Urban agriculture was not associated with better nutritional status indicators, but better socioeconomic status and maternal education were positively associated and highly correlated. Donated food's significant, negative association with HAZ and WAZ scores is likely a marker for those children who had already been identified with need for, and were receiving, food supplementation. While urban agriculture may represent one possible strategy for coping with food insecurity, its contribution should not be over-emphasized in the context of urban environments in Peru. Efforts to improve a household's socioeconomic status and increase educational opportunities for girls should be considered by policy makers.

Introduction

While significant progress has been achieved at reducing the number of undernourished children in the world, nearly 842 million people still suffer from chronic hunger (FAO 2013). UNICEF describes undernutrition as being underweight for one's age, too short for one's age (stunted), dangerously thin for one's height (wasted), and deficient in vitamins and minerals (UNICEF 2007).

Children are particularly susceptible to negative impacts from hunger. Proper nutrition protects against illness and forms a solid foundation for child growth and

development and adult outcomes, while undernutrition can lead to increased child morbidity and mortality and poor developmental outcomes (Adair 2013). Adequate nutrition, particularly during gestation and early childhood, contributes to organ formation and function, a strong immune system, and neurological and cognitive development. Individuals with proper nutrition can learn new skills, think critically, and provide benefit to their communities, which can lead to economic growth (WHO-UNICEF-The World Bank 2012). Undernutrition has been shown to be strongly associated with shorter adult height, less schooling, reduced economic productivity, and lower off-spring birth weight (Victora et al. 2008). Undernutrition is the underlying cause of 45% (3.1 million) of deaths of children under the age of 5 (Black et al. 2013).

Stunting is an important indicator of nutritional status. Defined as height-for-age Z-scores <-2 standard deviations compared to WHO child-growth standards (HAZ), it reflects being too short for one's age. Approximately 165 million children in the world age 5 years or younger are stunted (Black et al. 2013), including nearly one-third of children in developing countries (UNICEF 2007). Stunting reflects chronic malnutrition and is often the result of insufficient food, lack of vitamins and minerals, and frequent infections. Determinants include poor socioeconomic conditions, food insecurity, inadequate care, morbidity from infectious diseases, poor breastfeeding, inadequate complementary feeding, poor education, and lack of women's empowerment (WHO 2006; Black et al. 2008; Bhutta 2008).

The impact of stunting includes delayed motor development, impaired cognitive function, and poor school performance (UNICEF 2007). Stunting is seen as an indicator of a country's future human capital (Victora et al. 2008), and a decrease in stunting

typically indicates improvement in overall socioeconomic conditions (Onis et al. 1997). Improved height-for-age indicators in preschool have been shown to be associated with increased height as a young adult, more school completed, and an earlier age for starting school (Alderman et al. 2003). Existing interventions are available that could reduce stunting at 36 months by a third; however, long-term investments are needed (Bhutta et al. 2008).

Like stunting, underweight is a measure tracked to determine nutritional adequacy for children. Underweight is measured as having a weight-for-age Z-score that is <-2 standard deviations compared to WHO child-growth standards (WAZ). It indicates having low weight compare to children of the same age and sex, and is the most common indicator collected in growth monitoring. It represents both poor linear growth and body proportions due to undernutrition (FAO 2001). Approximately 1 in 4, or 143 million children under the age of 5 in the developing world are underweight (UNICEF 2013). Between 1990 and 2011, the proportion of underweight children in the developing world dropped from 28 percent to 17 percent (WHO 2012). Most of this progress was achieved prior to 2007-2008, when food price spikes stalled the momentum.

An estimated 100 million, or one in six children in developing countries are underweight (WHO 2011). In Peru, it is estimated that 24 percent of children under the age of 5 are stunted and over 5 percent are underweight (UNICEF 2012). Among children from birth to 12 months of age in Peru, predictors of underweight included age, sex, anthropometric measurements at birth, lack of breastfeeding, maternal height and weight, morbidity, and altitude of mother's origin (Iannatti et al. 2009). Being underweight as a child can have significant consequences. Underweight status

contributed to an estimated 1,957,530 deaths (19.0% of deaths in children <5 years) and 81.3 million DALYs (18.7% of DALYs in children <5 years) in children under 5 years of age in 2004. It was also found that an estimated 35% of child deaths could be attributed to child underweight and intrauterine growth restrictions (Black et al. 2008).

Measuring HAZ and WAZ is an important focus in both rural and urban areas of Peru. While children in rural areas of Peru often have worse malnutrition and growth rates, urban areas also need to be examined due to the increasing numbers moving from rural to urban areas (UNICEF 2006). Since 2008, more people in the world are living in urban areas than rural areas (UNFPA 2007). This trend will likely continue, with an estimated 2 out of 3 people expected to be living in urban areas by 2050 (UNFPA 2011). Living in urban areas provides the benefits of greater economic opportunities, access to education and health care, and improved sanitation. However, those living in urban areas are susceptible to sudden swings in food prices, as many rely solely on markets to obtain food. Other challenges include significant inequities in economic opportunities, which force many into poverty. Peru is no exception to the movement from rural to urban areas. An estimated 22.4 million people were living in urban areas in 2010, representing 78.6 percent of the country's population. By 2025, it is estimated that over 27.7 million people, or 81.3 percent of the country's population will be living in urban centers (UNWUP 2012).

Urban agriculture, defined as engaging in agricultural or livestock production within cities or towns, has shown promise in helping to shield urban families from food insecurity and low dietary diversity (Zezza 2008). Maxwell et al. found that urban agriculture was associated with improved quantity and quality of food consumption and

significantly higher HAZ in a study in Uganda (1998). Zezza et al. (2010) found an association between urban agriculture and indicators of dietary diversity using representative data from 15 developing or transitional countries. Many case studies have examined the link between urban agriculture and nutrition, but very few have used quantitative data to explore this relationship (Zezza 2010). No formal studies have evaluated urban agriculture in Peru.

This study attempts to address this gap by investigating urban agriculture's association with outcomes of child nutritional status. Results from this study may help inform future interventions focused on improving food security and dietary diversity among urban residents.

Methods

Study Setting

Data from the Young Lives Study, a 15-year longitudinal study following 12,000 children in Peru, Ethiopia, India (state of Andhra Pradesh), and Vietnam were analyzed. These countries were selected to include a range of cultural, economic, geographical, political, and social environments. Two cohorts of children were enrolled from each country. The older cohort included approximately 1,000 children from each country who were born in 1994-95, and the younger cohort included approximately 2,000 children who were born in 2001-02. Data were originally collected in 2002, with subsequent data collection taking place 3 years later. It is anticipated that five rounds of data will be collected, with the final round in 2016. Although the broader Young Lives study is longitudinal, revisiting the same children in later years, this analysis takes a cross-

sectional approach, looking at children from the younger cohort in Peru at the second data collection point when they were approximately 5 years of age (Barnett 2012).

Children in Peru were enrolled from urban, periurban, and rural areas in each of the three main geographic regions: the western coastal plain, the rugged mountainous central area of the Andes, and the eastern lowland jungle of the Amazon Basin. Since the focus of this study is urban agriculture, only data from urban areas were used. Peru has experienced significant economic growth during the last decade and is currently considered an upper-income country (Escobal 2008).

The Young Lives Study is managed and directed by researchers from Oxford University in England, and is funded by UK Aid from the Department for International Development and by the Netherlands Ministry of Foreign Affairs. Researchers from Lima, Peru—the Instituto de Investigacion Nutricional (IIN) and Grupo de Analisispara el Desarrollo (GRADE)—are managing the study components for Peru.

Study Population

The first round of data in the Young Lives study from Peru was collected in 2002 when children were 6-17.9 months old. The sample was gathered by first dividing the country into geographic regions by population size. A research team then ordered the 1,818 districts in the country using a poverty index that included factors such as infant mortality, housing, schooling, roads, and access to services. The top 5 percent of districts were excluded. Sample sites were 75 percent poor and 25 percent nonpoor (Wilson 2003)

Beginning with a random starting spot, a computer selected a sample of districts that covered urban, peri-urban, and jungle areas. A random population area within each

district area was chosen, followed by a randomized selection of a neighborhood and street block. Fieldworkers began at each selected block and enrolled children who were eligible and had consent of caregivers. This was done until the required number of children were enrolled. A total of 36,375 homes were visited, and 2,751 children were initially recruited for the younger and older cohorts in Peru (Escobal et al. 2003).

The data used for this analysis, round two of the Young Lives study in Peru, were collected from November 2006 to May 2007, when children were approximately 5 years old. Households that were enrolled in the first round were contacted in the second round, even if they had moved locations. Efforts to reduce attrition from the first to second round resulted in a 3.52 percent attrition rate, which was considered low when compared to similar studies (Outes-Leon and Dercon 2008).

A total of 1,086 children were living in urban areas when the second round of data in Peru was collected. Two observations were dropped because mother's education was not known, and another observation was dropped because HAZ score was not known, leaving a total of 1,083 observations.

Data Collection

Fieldworkers underwent extensive training to ensure questionnaires were given in a standardized manner (Escobal 2008). Households in round two were asked questions concerning: demographics; socioeconomic and cultural characteristics; public services; income and expenses; availability of assets and social capital; strategies for dealing with adversity; access to and use of public and private services; and perceptions of the family's well-being.

Caregivers of each child provided informed consent before the child was enrolled in each survey round. Fieldworkers ensured that caregivers understood that data were collected for a research project, and not the creation of a project that could change or benefit their lives. All data were archived anonymously. Institutional Review Board approval was obtained in the United Kingdom from the London South Bank University, London School of Hygiene and Tropical Medicine, the University of Reading, the University of Utah, and from the Instituto de Investigacion Nutricional (IIN) Ethics Committee in Peru. The Peru Ministry of Health also approved of the study, in addition to local community leaders.

Nutritional Status

Nutritional status was measured through the use of anthropometric indicators. At each survey round, Young Lives children were measured for height and weight, which allowed the calculation of undernutrition indicators like stunting (HAZ score <-2 standard deviations from the reference group), wasting (weight-for-height Z score < -2 standard deviations from the reference group), and underweight (WAZ score <-2 standard deviations from the reference group) (Escobal et al. 2003). These measurements use the WHO Child Growth Standards as a reference and serve as outcome variables (WHO 2006).

Urban Agriculture

Participation in urban agriculture was determined at the household level and is comprised of families living in urban areas that indicated they had grown crops or raised

livestock during the previous 12 months. Each household was labeled as either “rural” or “urban”, based on the location of residence. Families that had grown at least one crop or raised one type of livestock were categorized as having participated in urban agriculture. The time period of 12 months allowed for urban agriculture activity to be recorded, regardless of what time of year the survey was administered.

Covariates

Model covariates included the number of people in the household, socioeconomic status, maternal education, and access to donated food. At the beginning of the questionnaire for each round of the Young Lives study, caregivers were asked how many people were living in the household to determine the household size.

Socioeconomic status was derived using a wealth index that included a continuous measure from 0 to 1, with 1 being the wealthiest and 0 being the poorest. This measure was calculated using housing quality (number of rooms, household size, home construction materials, and type of floor), consumer durables (radio, refrigerator, bicycle, TV, vehicle, mobile phone, landline phone, iron, blender, gas or electric cooker, and record player), and access to services (drinking water, electricity, toilet, and fuel) (Escobal 2003).

Maternal education was determined by the number of years of schooling completed by the mother of the child. A categorical variable was constructed based on completion of the following grade levels: 0-5, 6, 7-10, 11-12, and some postsecondary. Caregivers were also asked if anyone in their household had received donated food and whether children in the study participated in a social assistance program called the Glass

of Milk Program.

Data Analysis

Descriptive analysis was conducted on several child, maternal, and household characteristics. Linear regression was run using Stata® to analyze associations between participation in urban agriculture and HAZ-scores and WAZ-scores.

Results

The mean age of children was just less than 5.5 years (Table 3.1) and the sample included the same number of males and females. The average number of years of maternal education was just under 10 years. Ethnicity was predominately Mestizo (82.27%), with Quecha (9.97%), White (3.42%), Aymara (2.95%), and other (1.39%) being represented. Maternal language spoken was largely Spanish (86.89%).

Urban areas were represented in each of the regions of Peru, with most respondents from the coastal region (63.62%), followed by the mountain region (27.24%), and the jungle region (9.14%). The mean score on the wealth index for this population was 0.62, based on a scale from 0 to 1. Households that reported having received donated food was 57.16%. The average household size was 5.14, although the proportion of adults and children within the homes is unknown.

Just under half of households reported participating in urban agriculture during the previous 12 months (47.00%). A total of 183 children (16.90%) were stunted and 29 (2.68%) were underweight with a WAZ score two standard deviations or more below the mean of the reference population.

In a linear regression model, household participation in urban agriculture was negatively associated with HAZ score in the unadjusted model, but the association was not significant when controlling for maternal education, wealth, household size, donated food, or participation in the Glass of Milk program (see Table 3.2). Maternal education of at least 7 years and wealth status were significantly associated with better HAZ-scores in both univariate and adjusted models. Participation in the Glass of Milk program was suggestive, but not significantly associated at the $p<0.05$ level in the adjusted model, but was significantly associated with poorer HAZ scores in the univariate model.

When looking at underweight, maternal education of at least 11 years or more and wealth were significantly associated with better outcomes (see Table 3.3). Household size and households that had received donated food were significantly associated with poorer WAZ-scores. Socioeconomic status seemed to have the largest impact on both indicators of nutritional status and was highly correlated with better HAZ and WAZ scores. Maternal education was also highly correlated with better HAZ and WAZ scores. Household size was not significantly associated with either HAZ or WAZ. When household size was categorized, households with 8 or more people showed a significant, negative association with WAZ scores.

Discussion

We found no positive association between participation in urban agriculture and the nutritional status (HAZ & WAZ) of children. This is in contrast with the study by Maxwell et al. that found a positive association between urban agriculture and higher HAZ scores in urban households in Uganda that participated in agriculture (1998).

Urban agriculture is sometimes employed as a coping strategy for food insecurity. Food from urban agriculture activities may not be seen as the largest source of food, but could be utilized when food is needed or used as a source for purchasing other goods. Using data from 15 countries, Zezza et al. found that in many countries, urban agriculture was not a major economic activity, but still provided a portion of livelihood for a significant number of households. They also found that urban agriculture did not play a substantial role in alleviating poverty in countries outside of Africa (2010). Further research is needed to understand the settings in which urban agriculture positively impacts both economic and nutritional status indicators.

Children of families with 8 or more people in the household had a significant negative association with WAZ. Assuming these families have a large number of children and not a number of contributing adults, it is presumed that with the greater number of children, there is greater demand for food in comparison to the number of people available to farm or earn money, which could limit consumption and prevent optimal growth. We also found that receipt of donated food was significantly, negatively associated with both HAZ and WAZ scores. This is not to say that donated food causes worse nutritional indicators, but is likely because children with poorer nutritional indicators are qualified for food donation programs. Within our cross-sectional dataset, it is impossible to determine causality, and only associations can be reported. This result outlines the importance of reviewing current social safety net programs to determine whether they are meeting the greatest needs. Our findings showed no significant association with improved HAZ or WAZ scores. This program, along with others, needs to be further evaluated to determine if it is reaching its goals.

We did find that higher socioeconomic status and maternal education were significantly, positively associated with child nutritional status. This was similar to findings from Ruel et al. who found that schooling directly increased earnings and income, which can positively impact nutrition over time (2013). Both variables were highly correlated, showing that efforts to increase a household's ability to improve socioeconomic status and improve education for girls could be possible areas of emphasis to be considered by policy makers.

We have not found evidence that urban agriculture improves child nutritional status. However, its use as a coping strategy should not be ignored. Ruel et al. reported that poor quality evaluations have limited the evidence of the nutritional impact of agricultural programs and made it largely inconclusive, aside for a few programs (2013). With the increasing number of urban poor, targeted interventions and appropriate policy are needed to help reduce undernutrition and possibly mitigate people's reliance on market-purchased food in urban areas.

This study has several limitations. The scope and breadth of participation in urban agriculture was not assessed, making it difficult to determine if an active or greater participation in urban agriculture would play a role in improving nutritional status. Varying definitions of urban agriculture is also a weakness. Because of this, comparison of this study to others may be difficult.

Conclusion

We hypothesized that household participation in urban agriculture would lead to better HAZ and WAZ indicators. Our findings suggest that urban agriculture was not

associated with better nutritional status indicators in urban areas of Peru. Zezza et al. cautioned that urban agriculture not be overemphasized, but at the same time, it should not be dismissed as a potential option for improving food security and nutrition (2010). While urban agriculture may not have as significant an impact on nutritional status as hypothesized, it could play a role as a coping strategy for food insecurity.

The current growth of population in urban areas will likely continue in future years. Identifying means to address food insecurity in urban centers will become increasingly important. Future research is needed to determine to what extent, if any, urban agriculture could play in improving childhood nutritional indicators.

Table 3.1 Characteristics of study population

Characteristics	N=1,083
Child Characteristics	
Child age in months	65.89 ± 4.14
Male (%)	51.06%
Female (%)	48.94%
Maternal Characteristics	
Maternal education in years	9.97 ± 3.74
Maternal ethnicity (%)	
Mestizo	82.27%
Quechua	9.97%
White	3.42%
Aymara	2.95%
Other	1.39%
Maternal language	
Spanish	86.89%
Quechua	8.77%
Aymara	3.69%
Spanish & Quechua	0.37%
n/a	0.28%
Household Characteristics	
Region (%)	
Coast	63.62%
Mountain	27.24%
Jungle	9.14%
Wealth index (score 0-1)	0.62 ± 0.17
Donated food (%)	57.16%
Household size	5.14 ± 2.01
Glass of Milk Program Participation	46.91%
Urban Agriculture	
Crops or Livestock (%)	47.00%
Nutritional Status	
Stunted (HAZ) (N=183)	16.90%
Mean HAZ	-1.10 ± 1.04
Underweight (WAZ) (N=29)	2.68%
Mean WAZ	-0.20 ± 1.06

Table 3.2 Regression results for nutritional status (HAZ score)

		Unadjusted Model		Adjusted Model		
Independent Variable	N	Estimate	95% CI	Estimate	95% CI	P-value
Urban Ag	1,083	-0.22	-0.34, -0.10	-0.06	-0.18, 0.07	0.366
Maternal Education						
0-5	119	--	--	--	--	--
6	125	0.28	0.03, 0.53	0.22	-0.03, 0.46	0.091
7-10	223	0.43	0.21, 0.66	0.30	0.07, 0.52	0.010
11-12	305	0.68	0.46, 0.89	0.50	0.28, 0.71	0.000
Some postsecondary	311	0.84	0.63, 1.05	0.55	0.33, 0.78	0.000
Wealth index	1,083	1.51	1.16, 1.85	0.98	0.59, 1.37	0.000
Household size	1,083	-0.04	-0.07, -0.01	-0.03	-0.06, 0.00	0.059
1-3	189	--	--	--	--	--
4-5	548	-0.08	-0.25, 0.10	-0.07	-0.24, 0.09	0.385
6-7	216	-0.24	-0.44, -0.04	-0.20	-0.39, 0.00	0.051
8+	130	-0.24	-0.47, -0.01	-0.19	-0.42, 0.04	0.102
Donated food	1,083	-0.33	-0.45, -0.20	-0.30	-0.50, -0.11	0.003
Glass of Milk	1,083	-0.19	-0.32, -0.07	0.19	-2.15, -1.51	0.055

Table 3.3 Regression results for nutritional status (WAZ score)

		Unadjusted Model		Adjusted Model		
Independent Variable	N	Estimate	95% CI	Estimate	95% CI	P-value
Urban Ag	1,083	-0.30	-0.41, -0.19	-0.10	-0.21, -0.00	0.100
Maternal Education						
0-5	119	--	--	--	--	--
6	125	0.16	0.20, 0.58	0.08	-0.13, 0.29	0.527
7-10	223	0.39	0.51, 0.87	0.21	0.23, 0.40	0.065
11-12	305	0.69	0.51, 0.87	0.46	0.27, 0.64	0.000
Some postsecondary	311	0.90	0.72, 1,08	0.53	0.34, 0.72	0.000
Wealth index	1,083	1.86	1.56, 2.15	1.26	0.93, 1.58	0.000
Household size						
1-3	189	--	--	--	--	--
4-5	548	-0.16	-0.34, 0.01	-0.15	-0.32, 0.01	0.068
6-7	216	-0.21	-0.42, -0.00	-0.15	-0.35, 0.05	0.135
8+	130	-0.29	-0.53, -0.06	-0.24	-0.47, -0.01	0.039
Donated food	1,083	-0.40	-0.50, -0.29	-0.27	-0.44, -0.11	0.007
Glass of Milk	1,083	-0.28	-0.38, -0.17	0.12	-0.04, 0.28	0.235

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CHAPTER 4

DETERMINANTS OF FOOD INSECURITY, DIETARY DIVERSITY, AND NUTRITIONAL STATUS AMONG POOR FAMILIES LIVING IN URBAN AREAS OF PERU

Abstract

Objective

The objective of this paper is to evaluate the determinants of food insecurity, dietary diversity, and nutritional status among poor families living in urban areas of Peru that are in the bottom two quartiles of a wealth index and identify characteristics of positive deviant families – those in the bottom two quartiles of a wealth index who did not report hunger.

Design

Using data from the second round of the Young Lives study in Peru, determinants of food insecurity, dietary diversity, and nutritional status were assessed using multivariate linear regression models. Resilient, or positive deviant, families were defined as families in the bottom two quartiles of the wealth index who were identified as being food secure or food insecure without hunger. Regression models were used to identify determinants of positive deviancy.

Results

Wealth was highly correlated with lower household (-2.579, p=0.022) and child food insecurity (-1.220, p=0.009). Participation in urban agriculture was also significantly associated with lower household food insecurity (-0.755, 0.008). A higher level of maternal education of at least 11-12 years was associated with lower food insecurity compared to mothers who had fewer years of education. Living in the Amazon jungle region of Peru was significantly associated (-1.001, 0.023) with lower household food insecurity compared to the coastal region. Household size was significantly associated with greater food insecurity.

Maternal education of at least 11 years, participation in urban agriculture, and living in the jungle region were significantly associated with being a positive deviant family. Having received donated food, access to credit/loans in the last 12 months, and having access to someone who can help in a time of need were not significantly associated with being a positive deviant household.

Conclusions

Increasing wealth of urban residents can help to mitigate food insecurity. Urban agriculture appears to be employed to help mitigate the negative impacts of food insecurity. Maternal education was also highly correlated with lower food insecurity scores. Programs and policies aimed to promote and improve these characteristics should be considered.

Introduction

The World Health Organization views hunger and malnutrition as the gravest threats to public health (Sheeran 2008). Undernutrition is a form of hunger and is the underlying cause of 45% (3.1 million) of deaths to children under the age of 5 (Black 2013). Children are particularly susceptible to negative impacts from hunger. Proper nutrition protects against illness and forms a solid foundation for child growth and development and adult outcomes, while undernutrition can lead to increased child morbidity and mortality and poor developmental outcomes (Adair 2013).

Increasing food prices brought on by changing diets, economic growth, an expanding world population, urbanization, use of food crops for biofuel, and inappropriate agricultural policies are threatening progress that has been made in recent years on addressing undernutrition (UN 2008). In 2011-2013, nearly 842 million people suffered from chronic hunger (FAO 2013), with 101 million children underweight, 165 million stunted, and 52 million wasted (UNICEF-WHO-World Bank 2012).

Lack of food security is an underlying cause of undernutrition. Food security is defined as consistent "physical, social and economic access to sufficient, safe and nutritious food that meets [one's] dietary needs and food preferences for an active and healthy life" (World Food Summit 1996). Measuring food security is important to ascertain access, availability, and utilization of food and respond to deficiencies, otherwise known as food insecurity (FAO 2013). Food insecurity is measured at the individual, household, regional, national, and international levels.

While there is enough food in the world to enable everyone to have a productive and healthy life, accessibility is a key issue to household food security. Families who do

not produce their own food suffer the most, because a larger proportion of their household expenditures go toward purchasing food. High food prices push people into poverty, with much of the increase in areas that already have a large population of people living in poverty (UN 2008).

Families living in urban areas can be particularly susceptible to food insecurity. While urban areas can provide greater access to economic, educational, and health resources, families are more susceptible to negative impacts of sudden swings in food prices, as many rely solely on markets for food (UNICEF 2012).

The number of people living in urban areas is increasing at a steady rate. In 2008, it was estimated that more people were living in urban areas than in rural areas, including over one billion children (UNFPA 2007; UNICEF 2012). Every year, the world's urban population increases by 60 million people, and by 2050, it is expected that 70 percent of the world's population will be living in urban areas (UNICEF 2012).

Peru has also experienced this urban movement, with an estimated 22.8 million people living in urban areas in 2011, representing 77.6 percent of the country's population (UN, 2014). Projections suggest that by 2025, over 27.7 million people will be living in urban centers in Peru, approximately 81.3 percent of the country's population (UNESA 2012). As the number of people moving to cities increases, urban poverty, malnutrition, and hunger will also increase (UNICEF 2012).

While interventions to help the rural poor are important, assistance for the urban poor is becoming increasingly urgent. Urban residents are just as vulnerable to scarcity and marginalization as rural dwellers, with 1 in 3 people in urban areas living in substandard conditions (UN-Habitat 2003). Urban children tend to fare better with regard

to indicators of well-being such as reaching their 5th birthday, schooling, and sanitation. However, these figures are collective measures, where the experiences of poorer urban children may be masked by children in wealthier homes. Wide disparities often exist in urban areas when it comes to child survival, opportunities for schooling, and nutritional status (UNICEF 2012).

Numerous policies and programs have been developed at the local, national, and international level to improve food insecurity in rural areas. With the inevitable increase in urban residents, it is important to better understand the predictors of food insecurity in urban households. Significant gaps in the literature remain on urban food insecurity. Having a better understanding of urban food insecurity will help in developing policies and programs that will benefit the increasing number of urban residents.

Methods

Study Setting

This analysis is a retrospective cross-sectional study nested within a larger cohort study called Young Lives, a 15-year, multicountry longitudinal study. Young Lives is managed and directed by researchers from Oxford University in England, and is funded by UK Aid from the Department for International Development and by the Netherlands Ministry of Foreign Affairs. The study follows 12,000 children in four countries: Peru, Ethiopia, India (state of Andhra Pradesh), and Vietnam. These countries were selected to include a range of cultural, economic, geographical, political, and social environments. Two cohorts of children were enrolled from each country. The older cohort included approximately 1,000 children from each country who were born in 1994-95, and the

younger cohort included approximately 2,000 children who were born in 2001-02.

Peruvian children were enrolled in urban, periurban, and rural areas from each of the main geographic regions: the western coastal plain, the rugged mountainous central area of the Andes, and the eastern lowland jungle of the Amazon Basin. Although the study collected data from both urban and rural areas, only data from households living in urban areas were used for this analysis. Peru has experienced significant economic growth during the last decade and is currently considered an upper-income country (Escobal 2008).

Study Population

Round one of the Young Lives study in Peru was collected in 2002. The goal of the sampling was to enroll approximately 2,000 children ages 6-17.9 months and 1,000 children ages 7-8 years old (not multiple gestation). The country was first divided into geographic regions by population size. The research team then ordered the 1,818 districts according to a poverty index that included factors like infant mortality, housing, schooling, roads, and access to services. The top 5 percent of districts were excluded. Sample sites were approximately 75 percent poor and 25 percent nonpoor (Wilson 2003).

A computer identified a sample of districts that covered rural, urban, periurban, and jungle areas. A random population area was then identified, and a randomly-selected neighborhood was chosen along with a street block. Fieldworkers began contacting each home on the block and neighboring blocks until the required number of children were enrolled. The team visited a total of 36,375 homes and 2,751 children were originally enrolled in both the older and younger cohorts (Escobal et al. 2003).

This study uses data from the younger cohort during the second round of data collection in Peru. Children were approximately 5 years old when data were collected during November 2006 to May 2007. Attrition between the first and second round was 3.52 percent, considered low when compared to similar studies (Oustes-Leon 2008).

Data Collection

Extensive training was provided to fieldworkers to ensure questionnaires were administered in a standardized manner (Escobal 2008). The household questionnaire for round two included information on: demographics; socioeconomic and cultural characteristics; income and expenses; availability of assets and social capital; strategies for dealing with adversity; access to and use of public and private services; and self-perception of the family's well-being.

Caregivers provided informed consent before a child was enrolled in the study and before each survey round. Children were not required to participate even with their parent's consent. Fieldworkers ensured that caregivers and children understood that the data were collected for a research project and not for a project that could benefit or change their lives. Data that were collected were archived anonymously.

Women and racial minorities were enrolled in the study. Efforts were made to ensure all participants knew what was involved in the study and what would be required of them. Although children and pregnant mothers were included, the study was non-invasive and did not put them at risk.

Institutional Review Board approval was obtained in the United Kingdom from London South Bank University, London School of Hygiene and Tropical Medicine, the

University of Reading, the University of Utah, and the Instituto de Investigacio Nutricional (IIN) Ethics Committee in Peru. The Peru Ministry of Health and local community leaders were also involved and provided approval. All data collected were de-identified.

Food Insecurity

An adapted version of the United States Department of Agriculture (USDA) Household Food Insecurity Measure (Bickel et al. 2000) was used to measure food insecurity. The tool was developed and tested for use in the Young Lives' household questionnaire in Peru (Vargas et al. 2010). Responses to 15 core questions were used to calculate a food insecurity score. The questions described experiences of whether the household had enough food or money to meet dietary needs. The tool also measured anxiety over lack of food and quality of food for both adults and children. Questions regarding the frequency of coping strategies used for food insecurity were included.

Fieldworkers conducted the survey in person with a caregiver of the child that was enrolled in the study. Each question asked if (yes/no), or how often (almost every month, some months, only 1 or 2 months, did not happen) a situation of food insecurity was experienced by the family over the previous 12 months. Each situation that was experienced by the family in the previous year was given a value of 1, while each situation that was not experienced by the family was given a value of 0. Scores were summed to calculate the food insecurity score—the higher the score, the more tenuous the household's food insecurity situation was. Lower scores indicated less food insecurity.

A continuous measure was calculated from the results of the survey to be used in linear regression models. Following the USDA standard (Bickel et al. 2000), a 10-point scale was created and categorized as ‘food secure’ (0 to 2.32), ‘food insecure without hunger’ (2.33 to 4.56), ‘food insecure with moderate hunger’ (4.57 to 6.53), or ‘food insecure with severe hunger (6.54 to 10).

Dietary Diversity

A simplified dietary diversity module was used to determine individual dietary diversity scores for the children enrolled in the Young Lives study. Individual dietary diversity provides a snapshot of nutrient adequacy and evaluates the variety of foods consumed by the child. The Young Lives survey followed general guidelines for collecting and analyzing dietary diversity developed by the Food and Agriculture Organization (FAO) (Kennedy et al. 2011).

Primary caregivers of Young Lives children were asked whether the child had consumed certain foods in 12 different food groups during the previous 24-hour period. These food groups included: cereals, roots/tubers, legumes or nuts, milk/milk products, eggs, meat/offal, chicken, fish/seafood, oil/fat, sugar/honey, fruits, and vegetables. Examples of each food group were given if needed (i.e., lentils, beans, or peas for the “legume” food group).

Each positive response was given a score of “1”, with the total number of food groups represented in the previous 24 hours serving as the individual dietary diversity score for the child. This score was used as a continuous measure in all analyses.

Nutritional Status

Nutritional status was measured through the use of anthropometric indicators. At each survey round, Young Lives children were measured for height and weight, which allowed the calculation of undernutrition indicators like stunting (height-for-age Z score <-2 standard deviations from the reference group), wasting (weight-for-height Z score < -2 standard deviations from the reference group), and underweight (WAZ score <-2 standard deviations from the reference group) (Escobal et al. 2003). These measurements use the WHO Child Growth Standards as a reference and serve as outcome variables (WHO 2006).

Covariates

Urban agriculture was determined by identifying whether families that were living in urban areas had grown crops or raised livestock during the previous 12 months. Families that had grown at least one crop or raised one type of livestock were recorded as having participated in urban agriculture. The time period of 12 months allowed for urban agriculture activity to be recorded, regardless of what time of year the survey was administered.

Maternal education was derived from the number of years that the mother had finished schooling. A categorical variable was constructed based on completion of the following grade levels: 0-5, 6, 7-10, 11-12, and some postsecondary. Household size included the total number of people living in the home when the survey was administered. Socioeconomic status was derived using a wealth index that included a continuous measure from 0 to 1. This measure was calculated using housing quality

(number of rooms, household size, home construction materials, and type of floor), consumer durables (radio, refrigerator, bicycle, TV, vehicle, mobile phone, landline phone, iron, blender, gas or electric cooker, and record player), and access to services (drinking water, electricity, toilet, and fuel) (Escobal 2003). Other exposure variables included the presence of the father in the household, geographic region of Peru, receipt of donated food, having received loans/credit in the last 12 months, and self-reported access to people who can help during a time of need.

Data Analysis

A total of 1,086 children in the Young Lives study were living in urban areas when the second round data were collected in Peru. Two observations were dropped from the analysis because mother's education was not known and three observations were dropped due to incomplete information on the food security questionnaire, leaving the total number of observations at 1,081. Multivariate linear regression models indicated results were strongly influenced by wealth. It was decided to categorize this group into four quartiles based on distribution of the wealth index: 1) 0.08-0.51; 2) 0.52-0.65; 3) 0.66-0.76; 4) 0.77-0.94. Children in households that were in the top two wealth quartiles were dropped, leaving 542 children in the bottom two quartiles. One additional child was dropped due to missing data on WAZ, leaving 541 total children in the study (Table 4.1).

Descriptive analysis was conducted on several child, maternal, and household characteristics that have been reported in other studies to be associated with food insecurity. These included: maternal education, the presence of the father in the household, household size, geographic region, receipt of donated food, having received

loans/credit in the last 12 months, access to people who can help during a time of need, wealth index, and participation in urban agriculture.

Linear regression models were estimated using Stata ® (Version 8, College Station, TX) to evaluate associations with the outcome variables of household food insecurity, child food insecurity, dietary diversity, and nutritional status (HAZ and WAZ) with the exposure variables noted previously.

After looking at the broad determinants of food insecurity, dietary diversity, and nutritional status, we focused on determinants of food insecurity among poorer families to identify if there were factors associated with lower food insecurity among these families. This approach uses the concept of positive deviance (Marsh 2004) to determine what practices or characteristics are present in poor socioeconomic households that are without hunger. Because we found wealth index to be highly predictive of food insecurity in the previously-mentioned multivariate linear regression model, we used logistic regression to help identify determinants of being a positive deviant household. Positive deviant households included those households in the bottom two quartiles of the wealth index that reported being ‘food secure’ or ‘food insecure without hunger’. These households were compared to families in the bottom two quartiles of wealth that were ‘food insecure’ with ‘moderate-’ or ‘severe hunger’ (see Table 4.2).

Logistic regression models were estimated using Stata ® (Version 8, College Station, TX) to analyze associations between positive deviant households and the exposure variables noted previously.

Results

The mean age of children was 5.45 years with an equivalent number of males and females (50.65% male). The average length of maternal education was 8.62 years. Ethnicity was predominantly Mestizo (82.26%), with Quecha (9.80%), Aymara (3.14%), White (2.96%), and other (1.84%) being represented. Maternal language spoken was largely Spanish (85.03%).

Urban areas were represented in each of the regions of Peru, with most respondents from the coastal region (60.63%), followed by the mountain region (28.10%), and then the jungle region (11.28%). The mean score on the wealth index for this population was 0.49, based on a scale from 0 to 1. The average household size was 5.02 persons. Resources available to assist households in times of need included receiving donated food (67.84% reporting this type of assistance in the last 12 months), loans/credit (25.32%), and access to people who can assist (78.93%). Participation in urban agriculture during the previous 12 months was reported in just over half of households (54.90%).

Household Food Insecurity

The association between food insecurity and exposure variables was tested using an adjusted linear regression model (Table 4.3). Food insecurity was a continuous measure from 1 to 15, with 1 being fully food secure and 15 being severely food insecure. Significant, negative estimates denote lower food insecurity, or a better overall food security situation. Significant, positive estimates represent greater food insecurity, or a larger number of food insecure events that were experienced in the previous year.

Wealth was significantly associated with lower food insecurity (-2.579, p=0.022), and had the largest coefficient. Participation in urban agriculture was also significantly associated with lower food insecurity (-0.755, p=0.008). Maternal education of 11-12 years and some postsecondary (-1.178, p=0.005, and-1.670, p=0.001, respectively) was significantly associated with lower food insecurity, and likely represents a threshold effect. Living in the Amazon jungle region of Peru was significantly associated (-1.001, p=0.023) with lower food insecurity.

Households that had access to people who could help in times of need were suggestive of reducing food insecurity, but did not reach statistical significance (p=0.066). Living in the mountain region was not significantly associated with food insecurity (p=0.269), nor was living in a family that had received a loan/credit in the last 12 months (p=0.271). The presence of the father in the home on a daily or weekly basis relative to no paternal presence was not statistically significant (p=0.161).

Households that received donated food were actually associated with higher food insecurity (bad outcome). Relative to household size of 2-3 people, all larger households were significantly associated with greater food insecurity.

Child Food Insecurity

Child food insecurity was measured using 6 questions on the food insecurity scale that dealt specifically with experiences of the child. Using a multivariate linear regression model (Table 4.3), findings were similar to the household food insecurity model. Wealth (-1.220, p=0.009), urban agriculture (-0.323, 0.006), and maternal education of 11-12 years and some postsecondary (-0.439, p=0.012, and -0.747, p=0.000, respectively) were

all significantly associated with lower food insecurity. Contrary to the household model, living in the jungle was not significantly associated with lower food insecurity (p=0.100), but was suggestive of significance. Similar to the household model, household size and having received donated food were associated with greater food insecurity. Having received a loan/credit in the last 12 months and access to people who could help in a time of need were not statistically significant.

Dietary Diversity

A multivariate linear regression model found a significant, positive association between dietary diversity and mothers with some postsecondary education (0.481, p=0.026). A positive, significant association was also found among those who reported having access to someone who could help in a time of need (0.484, p=0.001). Households with 6-7 members were significantly, negatively associated with dietary diversity (-0.473, p=0.018).

Wealth, participation in urban agriculture, having received donated food, having received a loan/credit, region of household, and presence of the father in the home were all not significantly associated with dietary diversity.

Height-for-age

Looking at HAZ, maternal education of at least 11 years was positively associated with better HAZ. Wealth was highly significant (1.143, p=0.001) with better HAZ. Living in the mountain region was significantly associated with poorer HAZ (-0.283, p=0.005) and living in the jungle region was suggestive of significance (-0.246, p=0.078).

Presence of the father in the home, household size, having received donated food or a loan/credit, and having access to people who can help were all not significantly associated with HAZ.

Weight-for-age

A linear regression model testing associations with WAZ found a significant, positive association with wealth (0.0758, p=0.018) and maternal education of 11-12 (0.311, p=0.010) and some postsecondary (0.516, p=0.000). Having received donated food (-0.214, p=0.012), living in the jungle region (-0.353, p=0.005), and household size of 2-3 (-0.214, p=0.037) were significantly, negatively associated with WAZ. Urban agriculture, having access to people who can help, having received a loan/credit and presence of the father in the home were not significantly associated with WAZ.

Discussion

With the increasing numbers and proportion of people living in urban areas, investigating the determinants of food insecurity in urban areas is of great need. Addressing the core problems for families that experience hunger is essential, particularly as it impacts the health and well-being of children.

Greater socioeconomic status is one of the strongest determinants of lower food insecurity scores in both household and child food insecurity multivariate models. This was also the case in the HAZ and WAZ multivariate models. Wealth was not significant in the dietary diversity model.

We found that mother's education was an important determinant of lower food

insecurity. It was interesting to note the difference between mothers who had 0-10 years of education vs. mother's with 11 years or more. Mothers with 11-12 years or some post-secondary education were highly associated with lower household and child food insecurity scores. Significant associations were also found in the models for HAZ and WAZ, with the dietary diversity model showing a significant relationship with mothers that had some postsecondary education. Maternal education of at least 11 years was also a predictor for being a positive deviant household. This finding illustrates the importance maternal education can have on decreasing food insecurity. Other studies have noted maternal education to be associated with decreased child mortality (Gakidou et al. 2010).

In this population of households in the bottom two quartiles of the wealth index, urban agriculture was positively associated with lower household and child food insecurity scores. Dietary diversity was suggestive, but not significantly associated. Urban agriculture could be a helpful method to mitigate the negative impacts of food insecurity. Best practices could be disseminated through education and programs aimed at lower-income households. Policy favoring urban agriculture is also an important aspect of enabling agriculture in urban environments. While other studies have found an association between HAZ and urban agriculture (Maxwell 1998), we did not find a significant association with either HAZ or WAZ.

For this study, we do not have information on the variety of agriculture or if the family consumed or sold their products. These factors might contribute to the dietary diversity experience. Families growing a monoculture may not increase diversity of homegrown food, but they may receive cash from sales of surplus while families growing a variety of foods may increase diversity but not reach calorie thresholds.

Household size was associated with poorer household and child food insecurity indicators and dietary diversity, but was not significantly associated with WAZ or HAZ. This implies that with the greater the number of household members, the more tenuous the food security situation is for the household, something that has been seen in other studies (Shariff 2008). However, the amount that impacts HAZ and WAZ is unclear. Using categories broken out by the distribution of household size, the largest estimates were found among households that had 6-7 members. Households with 8 or more members were not as strongly associated and had a lower estimate, suggesting that some members of the household may be older and possibly bringing income to the household. We also tested the frequency of the father in the home, but did not find a significant association on food insecurity, dietary diversity, HAZ, or WAZ.

The region where the household was located seems to play a factor in household food insecurity. Living in the jungle region of Peru was significantly associated with lower food insecurity compared to the coastal region. The exact reasons for this are unknown, but could be related to closer access to food from rural areas, better growing conditions, or better access to land than other regions.

The nonsignificant association of food insecurity with access to various protection measures like receiving donated food, receiving a loan or credit in the last 12 months, and having access to people who can help, was contrary to what we had expected. Donated food was actually associated with poorer food insecurity outcomes, which could possibly be due to the fact that families with a poorer food insecurity status are in need of, and have received, donated food. Access to loan or credit may not be a critical element to improving the food insecurity status of families in urban Peru.

It is also interesting that having received a loan/credit, access to people who can help, receiving donated food, and being in debt did not significantly impact food insecurity. Given their poor socioeconomic status, it is thought that access to these "safety nets" might lessen the impact of food insecurity of the home. The role of social protection programs should be reviewed to ensure that they are targeting the right families and meeting needs. Black et al. suggest that programs need to include complementary areas like agriculture, health, social protection, early child development, education, and water and sanitation to impact the determinants of nutrition (2013). Agricultural programs and social safety nets can play a role in lessening the impact of sudden, negative events in the household. However, evidence of the effectiveness of agricultural programs on nutrition of mothers and children is limited, with the exception of vitamin A (Black et al. 2013). Assessing the effectiveness of these programs is important, particularly in the context of urban environments.

Positive Deviants

The concept of resilience, or positive deviance, involves identifying individuals that have uncommon, but better outcomes than others, and learning what behaviors enable the desired outcome. This strategy has been shown to be a powerful method for creating change (Marsh 2004). Maternal education among positive deviant households was an important predictor of lower food insecurity for mothers with at least 11-12 years of education, similar to what was found among all households. Living in the jungle region and urban agriculture also had significant associations with lower food insecurity scores (good outcome). Despite having a lack of wealth resources, positive deviant

families appear to use urban agriculture as a mitigating mechanism for food insecurity. This suggests that urban agriculture could potentially be utilized as a means to supplement food and reduce food insecurity among urban households.

The negative association of household size with being a positive deviant household is somewhat similar to other studies that have found that household size increases food insecurity (Shariff 2008).

This study used a cross-sectional approach to determine predictors of household and child food insecurity, dietary diversity, HAZ, and WAZ, as well as predictors of resilience. One limitation to this study is the lack of information on urban agriculture regarding the amount of land used and amount of food produced. Survey questions also asked about experiences over the previous 12 months, which could introduce response bias. Not knowing the age distribution of the household could also be a limitation, since older members of the household could be an important part of providing income and improving the food insecurity status of the household.

Conclusion

The number of urban poor is increasing, as well as the need to help identify strategies to address urban food insecurity. Ruel et al. has suggested that a comprehensive approach is needed to include programs in agriculture, social safety nets, early childhood development, and education (2013). This study found that wealth, maternal education, and urban agriculture provide a protection against food insecurity in urban areas. Urban agriculture and maternal education were also key predictors for being a positive deviant

household. Because of the increasing disparity found among urban households, identifying key programs and policies to improve urban food insecurity is of great need.

Table 4.1 –Distribution by wealth index and food security status to identify positive deviant families

	Wealth quartile		
Food Security*	1	2	Total
1	150 (55.97%)	188 (68.86%)	338 (62.48%)
2	69 (25.75%)	41 (15.02%)	110 (20.33%)
3	28 (10.45%)	26 (9.52%)	54 (9.98%)
4	21 (7.84%)	18 (6.59%)	39 (7.21%)
Total	268 (100%)	273 (100%)	541 (100%)

*1=food secure; 2=food insecure without hunger; 3=food insecure with moderate hunger; 4=food insecure with severe hunger

Positive deviant families in bold = Families that were food secure or food insecure without hunger in the bottom two quartiles of the wealth index

Table 4.2 Characteristics of study population

Characteristics	N=541
Child Characteristics	
Child age in months	65.37 ± 4.09
Male (%)	50.65%
Female (%)	49.35%
Maternal Characteristics	
Maternal education in years	8.62 ± 3.74
Maternal ethnicity (%)	
Mestizo	82.26%
Quechua	9.80%
White	2.96%
Aymara	3.14%
Other	1.84%
Maternal language	
Spanish	85.03%
Quechua	10.17%
Aymara	4.07%
Spanish & Quechua	0.37%
n/a	0.37%
Household Characteristics	
Region (%)	
Coast	60.63%
Mountain	28.10%
Jungle	11.28%
Wealth index (score 0-1)	0.49 ± 0.13
Receive donated food (%)	67.84%
Household size	5.02 ± 1.94
Received loan/credit in last 12mo/	25.32%
People who can help	78.93%
Urban Agriculture	
Crops or Livestock (%)	54.90%

Table 4.3 Linear regression analyses for food insecurity, dietary diversity, HAZ, and WAZ

		Food Insecurity									
Independent Variable		Household		Child		Dietary Diversity		HAZ		WAZ	
Mother's Ed (yrs)	N	Estimate	P-value	Estimate	P-value	Estimate	P-value	Estimate	P-value	Estimate	P-value
0-5	96	--	--	--	--	--	--	--	--	--	--
6	85	0.151	0.745	0.098	0.611	0.086	0.682	0.211	0.153	0.118	0.369
7-10	133	-0.061	0.885	-0.071	0.691	-0.092	0.631	0.216	0.114	0.181	0.139
11-12	140	-1.178	0.005*	-0.439	0.012*	0.357	0.061	0.387	0.004*	0.311	0.010*
Some postsec	87	-1.670	0.001*	-0.747	0.000*	0.481	0.026*	0.42	0.006*	0.516	0.000*
Father's Presence											
Yearly/Never	69	--	--	--	--	--	--	--	--	--	--
Wk/Biwk/Mon	65	-0.014	0.978	0.114	0.606	0.081	0.738	0.278	0.103	0.081	0.593
Daily	402	-0.573	0.161	-0.087	0.608	0.198	0.283	0.136	0.296	0.054	0.641
Household Size											
2-3	108	--	--	--	--	--	--	--	--	--	--
4-5	268	0.992	0.006**	0.425	0.005**	-0.291	0.074	-0.128	0.265	-0.214	0.037**
6-7	102	1.434	0.001**	0.815	0.000**	-0.473	0.018**	-0.231	0.101	-0.179	0.155
8+	63	1.132	0.026**	0.506	0.016**	-0.191	0.405	-0.211	0.191	-0.235	0.103
Region+											
Costa	328	--	--	--	--	--	--	--	--	--	--
Sierra	153	-0.346	0.269	-0.126	0.332	-0.261	0.065	-0.283	0.005**	-0.133	0.136
Jungle	61	-1.001	0.023*	-0.298	0.100	0.046	0.815	-0.246	0.078	-0.353	0.005**
Donated food	541	0.783	0.009**	0.258	0.036**	-0.113	0.399	-0.162	0.086	-0.214	0.012**
Loan/Credit 12mo	541	0.342	0.271	0.091	0.480*	-0.055	0.696	0.107	0.28*	0.058	0.512
People who can help	541	-0.615	0.066	-0.225	0.104	0.484	0.001*	0.146	0.172	0.078	0.413
Wealth	541	-2.579	0.022*	-1.22	0.009*	0.648	0.199	1.143	0.001*	0.758	0.018*
Urban Agriculture	541	-0.755	0.008*	-0.323	0.006*	0.218	0.087	-0.155	0.085	-0.102	0.204

*Indicates significant values for poorer outcomes
**Indicates significant values for better outcomes

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CHAPTER 5

CONCLUSION

Urban areas will no doubt continue to see increases in population in the coming years. Because urban families are much more susceptible to sudden increases in food prices, it is important to identify ways to help prevent or mitigate negative impacts on household food security resulting from market forces.

Using data from the Young Lives Study, the impact of urban agriculture on food insecurity, dietary diversity, and nutritional status was explored. Additionally, determinants of food insecurity were explored.

Wealth and maternal education had the strongest association with better food insecurity scores. Efforts to improve the economic situation of urban households are important in tackling hunger in urban centers. Because 1/3 of the world's urban population is living in substandard housing, programs and policies aimed at lifting these households out of poverty should be a focus. Education was shown to be highly associated with better food insecurity, dietary diversity, and nutritional status indicators. Educating girls, future mothers, should be a consistent focus in urban areas.

Although urban agriculture was not associated with better nutritional status indicators or dietary diversity scores, it was associated with improved household food insecurity scores. These findings suggest that urban agriculture could be a means to

buffer household food sources. Additional research is needed to explore methods of utilizing urban agriculture to improve dietary diversity in households.

Although urban agriculture is not seen as the answer to relieving hunger in all urban areas, its impact should not be dismissed. Families that are significantly impacted by rises in food prices could use urban agriculture as a means to minimize the negative impact, as well as increase diversity in the diet. Urban areas are all different and any potential for urban agriculture to be a possibility will need to be investigated in a location-specific manner. Where possible, policies could be established by governments and urban planners to promote the use of urban agriculture to improve food security and dietary diversity.

Efforts to improve safety nets for urban households should also be explored. Households that received donated food were found to have worse food insecurity measures, likely because children were in need of, and were receiving, donated food. The options for safety nets and the manner in which they are delivered should be explored to ensure they are meeting the needs. Debt was also found to be significantly associated with greater food insecurity, indicating a need to help households eliminate and stay out of debt.

When exploring determinants of food insecurity among positive deviant households, wealth, maternal education, and urban agriculture were again associated with improved food insecurity scores.

The current growth of population in urban areas will likely continue in future years. Determining means to address food insecurity in urban centers will become increasingly important. Future research is needed to determine to what extent, if any,

urban agriculture could play in improving childhood nutritional indicators. Ruel et al. have suggested that a comprehensive approach is needed to include programs in agriculture, social safety nets, early childhood development, and education (2013). This study found that wealth, maternal education, and urban agriculture provide a protection against food insecurity in urban areas. Because of the increasing disparity found among urban households, identifying key programs and policies to assist with urban food insecurity is of great need.

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